Computing and Telecommunications Architecture Guidelines - Middleware

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Introduction

Middleware facilitates communication between and among applications. It facilitates access to information and provides the user with authorized information. According to Gary Wright, IBM Global Services in the white paper "Middleware Direction at DIS OS/390 and Unisys Data Sources" it is sometimes referred to as "glue" because it joins together parts of an application distributed across a network.

In the same paper, Middleware is described as a "productivity tool" because it provides re-usable software for performing detailed communications tasks. The paper then notes:

> "Middleware is considered to be a layer of system software between the application and operating system that facilitates communication to another part of the same application or other applications that reside on a different computer connected to a network. As system software, Middleware has components that are installed and configured on the various computers."

Middleware will handle the establishment, management, and termination of connections and will transform data into streams that can be sent and received across the network. Middleware is also responsible for:

- **Marshalling**: Transforming data from the calling application into a form that can be transmitted over the network.

- **Routing**: Finding the right place to direct the message.

- **Delivery**: Streaming a copy of the bits from one place to another and implementing the communication logic required by network protocol and the remote application.

- **Syntax and Format Transformation**: Reformatting the layout of data contained within the messages not addressed by marshalling and unmarshaling, i.e. changing mmddyy to yyyymmdd

Integration Middleware: focuses on inter-application communications. This is likely to be the most important area for agencies to focus on the benefits of middleware. The principal functionality in the category of communications include:

- **Gateway** middleware that translates one protocol or API (Application Programming Interface) to a different one. For example a data manipulation language is translated to a different one. SQL may be translated to a hierarchical database such as IBM's IMS or SAGA's Adabas.

- **Extract, Transformation and Load (ELT)** applications have been used for many years to move data from one or more non-relational databases to a relational database. It is commonly used to build Data Warehouses and in using message techniques.

- **Wrappers** are software that contains ("wraps around") other data or software so that the contained elements can exist in the newer system. The term is often used with objects (component software) where a wrapper is placed around a legacy routine to make it behave like an object, but in a different manner that "object encapsulation". This middleware covers the protocol and logic of the remote application into a component interface.

- **Screen Scraping** middleware provides and API to terminal applications. This middleware could be included in the Gateways or Wrapper categories because it uses the same transformation techniques. While once out of favor, screen-scraping middleware has been rejuvenated due to easier installation and support by using a browser technology and Applets and because it continues to provide a non-invasive way to connect to a legacy application.

- **Broker** middleware connects one or more applications by introducing a third party, the broker software. It is sometimes called a hub because it is a central point through which information flows to various applications. The most common type of broker is the message broker. Brokers typically provide asynchronous or near real-time connections.

- **Message Oriented Middleware (MOM)** provides an asynchronous client-server infrastructure that increases the interoperability, portability and flexibility of an application by allowing the applications to be distributed over multiple heterogeneous platforms.

- **Business Process Managers/Workflow** middleware is similar to Message Broker in that they have intelligent routing capability and can transform

messages. However, they go beyond these capabilities and also provide the ability to manage the interactions among different applications.

Statutory Authority

The provisions of RCW 43.105.041 detail the powers and duties of the ISB, including the authority to develop statewide or interagency information services and technical policies, standards, and procedures.

Scope

These guidelines apply to all executive and judicial branch agencies and educational institutions, as provided by law, that operate, manage, or use IT services or equipment to support critical state business functions.

Exemptions

None.

Guidelines

Middleware Standard Candidates

There is a general industry consensus that middleware standards will emerge over time. Solutions to emerging needs are essential and will be sought in the interim. The Object Management Group (OMG) has developed **C**ommon **O**bject **R**equest **B**roker **A**rchitecture (**CORBA**) a widely used middleware standard. CORBA provides a way to execute programs (objects) written in different programming languages running on different platforms no matter where they reside in the network. CORBA is described at:

http://www.omg.org/gettingstarted/

Microsoft has developed **S**imple **O**bject Access **P**rotocol (**SOAP**), a product that is based upon XML. It is an open product that employs XML syntax to send text commands across the Internet using HTTP, and is described to be similar in purpose to COM and CORBA distributed object systems, but with lighter weight and less programming intensity. Microsoft says it will remain open if a standards body adopts it or it will otherwise become a defacto standard if a sufficient number of users adopt it.

A SOAP tool kit is available free for developers at:

http://ipw.internet.com/development/software_development/960221792.html

The State of Washington, Department of Information Services (DIS) Computer Services Division has developed a middleware web site that is helpful in guiding agencies in the deployment of middleware solutions. The site also compares products and defines the

terms-of-art that one must know to address middleware solutions. You may access the site at the address noted below:

http://sww.wa.gov/customerinfo/techsvcs/default.asp?arg1=midware

You may also add yourself to the list serve that will provide you updated information from this dynamic site by accessing:

http://listserv.wa.gov/cgi-bin/wa?SUBED1=dis-middleware&A=1

Evaluation Criteria for Middleware

There are hardware vendor middleware solutions but they often link you only to their products in order to benefit from the solution. Before making a selection it is important to evaluate the product, being wary of it limiting you to using the product only in connection with the vendor's products. There are many neutral vendors striving to provide products that reach across systems and interact with most available systems. The evaluation criteria presented in the appendix will assist you in your evaluation of Middleware products. The criteria are grouped into categories like a requirements list for an RFP. Like any RFP evaluation, a team is expected to construct the requirements and determine the relative importance of each item to be considered. The list need not include all items listed in the appendix. Agencies may have particular needs that require specific application response and those features should be defined, added to the list and be weighted. It is important to make the list generic so as to avoid any bias to a specific vendor.

Related Policies, Standards, and Guidelines

Computing and Telecommunications Architecture Policy
Computing and Telecommunications Architecture Standards – Operating and Database Management Systems

Maintenance

Technological advances and changes in the business requirements of agencies will necessitate periodic revisions to policies, standards, and guidelines. The Department of Information Services is responsible for routine maintenance of these to keep them current. Major policy changes will require the approval of the ISB.

Appendix: Middleware Evaluation Criteria
Technical

Weight	Item
	Ease of Use
	Security
	User requirements
	Stability
	Availability
	Number of systems supported
	Compatibility with current infrastructure
	Performance reporting and monitoring
	Scalability
	Related platform requirements

Support/Training

Weight	Item
	Competence of the vendor to support the installation
	Training
	Vendor support
	Ease of maintenance/administration

Architectural Standards

Weight	Item
	Industry direction/standards
	Market share
	Open architecture
	Alignment with ISB & DIS policy and statement of direction
	Thin-client per TAAG standards

Financial

Weight	Item
	Cost
	Billing/metering

On the following pages you will find a description of issues to consider for each section of the table above. It is not exhaustive and may only point an agency to typical issues they may want to consider.

TECHNICAL

1. Ease of Use

a. Does the product meet Federal and State of Washington requirements?

b. Is support such as online help and tutorials included?

c. Is documentation provided? If so, in what format?

d. Does the product provide a Graphical User Interface?

e. What tools are provided to simplify software processes (product menu driven, as opposed to command line driven, 'wizards', code generators, templates, etc.)?

f. Does the product support the TAAG (Technology Architecture Advisory Group) guidelines in "Section 1: Provide high quality user experience " at http://www.wa.gov/dis/e-gov/architecture/taag.htm?

2. Security

a. Will the product interface with or use DIS'/Agency's existing security architectures?

b. Does the product have its own security system to provide user identification and authentication, resource access controls, auditing, and security administration? If yes do they meet state standards?

c. Does the product avoid I/O's to retrieve or process data by first checking the user's authority to access or process the data?

d. Can the product security administration be delegated? Can the product support a central security administrator, two or more independent subordinate security administrators, and an overlapping user base?

e. Are product exits, or exits in the existing security architectures, required to achieve the distribution of administrative authority between DIS/Agency and users?

   1). What steps are required to accomplish this distribution of authority?

f. What steps are required to define a new or to remove a resource from the product?

   1). Who may perform this function (DIS/Agency or user security administrators)?

g. What steps are required to allow a new user id or remove a user id's access to a resource within the product?

   1). Who may perform this function, DIS/Agency or user security administrators?

h. What steps are required to modify a users access to an existing resource within the product?

   1). Who may perform this function, DIS/Agency or user security administrators?

i. If the product has a proprietary security system, does it provide the following administration tools?

   1). Real-time & batch methods to add, remove, and modify user ids, user groups, resources, and resource access?
   2). A real-time & batch method to list authorized user ids and/or groups for each resource under its control and the level of access they have?
   3). A real-time & batch method to list all its resources and the access each user id and/or group has to those resources?
   4). A logging mechanism to record all security administration commands affecting users, user-groups, resources, and resources accesses.
   5). A logging mechanism to record all resource access violations and optionally record successful accesses?
   6). A real-time & batch method to list all logged security administration commands affecting users, user-groups, resources, and resources accesses?
   7). A real-time & batch method to list all resource access violations and optional successful accesses?

j. If the product has a hybrid security system (part internal or proprietary and part interface to existing security architectures), answer each of the questions in the preceding section for each part of the hybrid (internal/proprietary and interface).

k. Encryption.
   1). Does the product support encryption of data and security information (user id/password)?
   2). Is the encryption one-way encryption?
   3). Can the encryption be turned off?

l. Does the product allow the execution of system commands? If yes, can the type of commands executed be controlled?

m. Does the product support certificates of authenticity?

n. Does the product provide an audit trail of activity?

  o. Does the product require an explicit security challenge of the user to complete a transaction?
    1). Can it be turned off?

3. **User requirements**

  a. Is a user currently using the product?

  b. Do we have a user request for the product?

  c. Are the user requirements to be solved by the product known?

  d. Does the product meet essential user requirements?

  e. Does the product meet other user requirements?

4. **Stability**

  a. Are reliability statistics on the product available (Mean Time Between Failures (MTBF), % of availability, etc.)?

  b. Are independent reviews/evaluations of the product available (Datapro, Gartner, etc)?

  c. How many licensed copies of the product have been installed? Will the vendor provide customer references where the product is in a production setting?

  d. How long has the product been "generally available"?

  e. How many maintenance releases of the product been issued?

  f. Does the product have restart/recovery capabilities?

  g. What features in the product are available to prevent one application from adversely affecting another?

  h. How does the product support multi-server implementation with fail-over capabilities (e.g. clustering, HACMP, etc)?

5. **Availability**

  a. Can the product run 24 hours a day, 7 days a week?

  b. Which maintenance/administrative tasks can be performed dynamically?

   c. How much time is required to:
      1). Shut down
      2). Perform maintenance/administrative tasks
      3). Restart

   d. What is the frequency of occurrences for:
      1). Shut down
      2). Performance of maintenance/administrative tasks
      3). Restart

   e. Is there any impact to users during maintenance application/product administration?

6. Number of operating systems supported

   a. In which of the following operating environments can the product run?
      1) UNISYS OS2200
      2) IBM OS/390
      3) HP-UX
      4) Sun Solaris
      5) RS6000 AIX
      6) Tandem
      7) Windows NT
      8) Windows 95
      9) Windows 98
      10) Windows 2000

   b. What maintenance/release level is required to run in each of the previously identified operating environments?

7. Compatibility with current infrastructure

   a. Does the product have a duplicate functionality that already exists at DIS/Agency?

   b. Does the product require other products be installed at a certain level in order to work properly?

   c. Does the product have co-requisite products? If so, how will they be addressed?

8. Performance reporting, monitoring, and tuning

   a. Does the product have built-in performance monitoring tools?

   b. Does the product allow performance settings to be changed dynamically?

c. Does the product support ad hoc performance reporting?

d. Does the product support scheduled (recurrent) performance reporting?

e. Can the product's performance reports be customized?

f. Does the product interface with external performance monitoring tools (e.g. The Monitor, Omegamon, Unicenter, etc)?

g. Does the product supply centralized real-time and historical reporting of the response time and utilization of each system and link involved?

9. **Scalability/How the package handles increased workloads**

a. Is increased workload handled by multiple instances?

b. Can multiple instances run in a single O/S?

c. Can this product be scaled on the following platforms?
    1). AIX
    2). SOLARIS
    3). HP/UX
    4). UNISYS
    5). OS/390
    6). Windows N/T
    7). Windows 2000
    8). Windows 98
    9). Windows 95
    10). TANDEM

d. Can the product communicate with its counterpart on other sizes of platforms/servers?

e. What resources and actions are needed to rescale the product, including limits, additional preparation/lead time, added hardware/software requirements, additional licenses required, and all other technical requirements?

10. **Co-requirements**
    a. Will DIS/Agency have to install other software in order for this product to function? (If so, include the cost of the other software in the 'Costs' section.)

SUPPORT/TRAINING

1. **Vendor competence to support the installation**

a. Require the vendor to specify who will be lead the engagement and who will support the leader.

b. Require resumes for each person that demonstrate their experience with installing the product

2. Training

a. Type of product training.
1). Is in-state, on-site classroom training feasible?
2). Is out-of-state classroom training required?
3). Is Computer based training available?
4). Is one-on-one training available?
5). Is training available on a vendor supplied (non-production) system?
6). Is training available on a state supplied non-production system?
7). Is training available on a state supplied production system?

b. How much training is required?
1). What is the duration of the vendor supplied training for each of the above-defined types that are included in initial installations?

c. Training cost to the state of each type of training defined in b. above

3. Vendor support

a. What support is available for the product? (E.g. Telephone, web-based, on-site, etc) and for who long will it be offered for the following:

1). Is telephone support available for the product?
2). Is the telephone support available within the continental United States?
3). Is web-based support available for the product?
4). Is on-site support available for the product?

b. Is the vendor support available 24x7?

1). Is telephone product support available all of the time?
2). Is web-based product support available all of the time?
3). Is on-site support available all of the time?

c. What costs are charged for the support services

1). For the first 90 days after acceptance of the system?
2). For the next year after acceptance of the system?
3). Thereafter?

d. How often does the vendor release maintenance to the product?

   1). Does the vendor notify customers of releases to the product?
   2). Does the vendor notify customers of fixes to current releases of the product?
   3). Does notification of fixes come via e-mail?
   4). Does notification come via standard mail?
   5). Can software fixes be downloaded via the Internet or FTP?
   6). Are new releases or versions of software automatically shipped to the customer?

4. Ease of maintenance/administration

a. Are product requirements and documentation for installation, maintenance, and administration available and understandable?

   1). Are product requirements for installation provided?
   2). Are product requirements for maintenance provided?
   3). Are product requirements for administration provided?

b. Is product maintenance performed by industry standard:
   1). Library/module replacement method?
   2). SMP/E method for S/390 mainframes?

c. What features within the product facilitate the testing of product updates and changes prior to implementing into a production environment?

d. Does the product include tools to simplify maintenance?

e. Does the product include tools to simplify administration?

f. Does the product support remote administration?

ARCHITECTURAL STANDARDS

1. Industry direction/standards

a. What architectural standards does the product support? (e.g. TCP/IP, CORBA, EJB, ODBC, LDAP, SOAP, etc.)

b. What other products in the marketplace use the same architectural standards as this product?

c. Does the product support standards identified as industry leaders by independent organizations such as Gartner Group?

2. Market share

a. Does the product have at least a 10% share of the market for its middleware product type?

3. Alignment with ISB & DIS policy and statement of direction

a. Does the use and implementation of this software adhere to ISB and DIS policies/direction?

4. Thin-client per TAAG standards

a. Does the product support thin client?
b. Does the product support thick client?
c. Is the product accessible from a "green screen?"
d. Is the product accessible as a client?

FINANCIAL

1. Cost

a. Product costs
   1). What is the initial purchase price?
   2). What is the purchase price based on (e.g. site license, individual user license, concurrent user)?
   3). What is the annual maintenance cost?
   4). When does the warranty period end and maintenance begin?
   5). What is the cost for capacity upgrades?
   6). Is support like training and documentation included in the maintenance cost or is it as separate cost?

b. Is the cost of the software negotiable with the vendor?

c. What are the equivalent costs for competing products? This will be provided by the competition, and it may vary depending upon a number of issues.

2. Billing/metering

a. Does the product provide a way to meter its usage?

   1). If so, what is the metric used for that purpose? For example, disk space allocated or used, CPU usage, number of users and a way to identify those users (e.g. the user id's of those users), etc.

b. Does the product provide reporting facilities for resource utilization?

c. Which of the following formats can the product use to store utilization data?
   1). EXCEL
   2). WORD
   3). MS SQL
   4). IBM DB2
   5). Lotus DOMINO
   6). System 390 VSAM file
   7). System 390 sequential file
   8). ASCII file
   9). ASCII flat text file